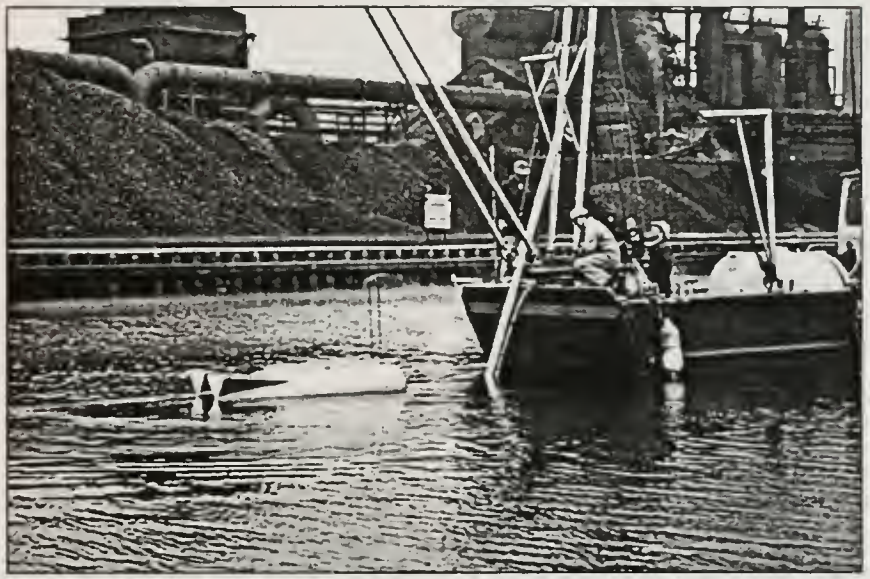
Limnofix Apparatus to Detoxify and Improve Natural Biodegradation of Contaminated River and Lake Sediments (LISSTT)

" The Limnofix sediment treatment technology (LISSTT) is a process to add chemicals to sediment in place to alter the chemical and physical status of the sediments to achieve site-specific remediation goals. The main targets of the process are improved bioremediation of organic contaminants (e.g. PAHs, petroleum hydrocarbons) and odor and nutrient control. This process was developed as a cost-effective method of remediating contaminated aquatic sites as an alternative to traditional removal and ex-situ treatment and/or disposal. "

Jay Babin
Principal
Limnofix



Limnofix system at work on Hamilton Harbour sediments.

THE COMPANY

The technology is patented by Environment Canada. Golder Associates has negotiated a licence to commercialize and implement LISSTT through the Golder Associates worldwide group of companies. Golder Associates is an international group of environmental engineering companies that specialize in providing clients with innovative solutions to their environmental needs. There are more than 1,800 employees in 70 offices in North and South America, Australia, Europe, Scandinavia and Asia. Limnofix is the Canadian aquatic remediation company of Golder Associates.

THE CHALLENGE

LISSTT was developed by Environment Canada to provide an economical method of remediating aquatic sites contaminated with biodegradable, or excessive amounts of organic compounds by adding specific chemicals to site sediments. The added chemicals stimulate bacteria already present to break down the contaminants. Virtually all contaminated aquatic sites are anoxic — that is, lack oxygen — and inhibit the bacterial breakdown of contaminants. Consequently, the ultimate goal of LISSTT is to oxidize to the sediments.

TECHNOLOGY DESCRIPTION

Treatability assessment: Contaminated sediments are collected and subjected to bench-scale tests to assess the effectiveness of the proposed treatment and to determine the appropriate chemical dosages under this technology. These treatability studies involve adding various combinations of oxidants and amendments to sediment samples based upon their chemical and physical characteristics and the types and amounts of contaminants present. The samples are allowed to incubate and biological activity is monitored. The sample(s) with the greatest biological activity are re-analysed for the contaminants of concern. A pilot-scale or full-scale treatment is then proposed, based on the results of the bench-scale tests.

Pilot-scale treatment involves treating a small area of contamination to determine the ability of LISSTT to clean up the contaminants under the site-specific conditions. The treatment effectiveness is determined by an intensive monitoring program. A decision to continue and expand the treatment (i.e. full-scale) depends on the results of a pilot-scale test.

Full-scale treatment involves treating the entire area to reduce contamination to below a target level. If a series of treatments is required, then a monitoring program is implemented between treatments.

Treatments (pilot-scale or full-scale) are accomplished by adding the chemicals (site-specific in terms of formulae and dosages) directly into the sediments through a patented 8m-wide injection boom. Chemicals are stored on board the injection boat and pumped to the injection boom at a predetermined rate to deliver the necessary chemical dosage. The hardware currently in use can treat in excess of one hectare/day and has been used in marine and freshwater environments up to 22 metres deep.

RESULTS

The addition of oxidants to contaminated sediments has consistently reduced the acute toxicity of the sediments by almost 100 per cent. This reduction has enabled the local bacteria to biodegrade the organic contaminants. Volatile organics (BTEX) are biodegraded most rapidly, followed by petroleum hydrocarbons (TPH) and then polynuclear aromatic hydrocarbons (PAHs). Pilot-scale treatments to degrade organic contamination at one site in Hamilton Harbour resulted in the removal of 75 per cent of the BTEX, 50 per cent of the TPH and 20 per cent of the PAHs.

Odor control (removal of sulphides) has been achieved in pilot-scale tests in Hong Kong by addition of an oxidant to the sediments. The pilot-scale tests have shown a reduction of 98 per cent of the odor-causing sulphides which are converted to non-odorous sulphates.

Pilot-scale treatments in Japan for nutrient control have shown a reduction in phosphorous concentrations of up to 99 per cent in sediments in freshwater systems.

In all the pilot-scale tests to date, source control has been shown to be important for complete and successful remediation of contaminated sites.

The market for this technology is worldwide for remediation of contaminated sites and for control of odors and of eutrophication. The cost of cleaning up contaminated sites with this technology is approximately 20 per cent of the cost for dredging and land farming. The technology is currently undergoing full-scale commercialization; projects are underway in the United States and Japan.

TECHNOLOGY OPPORTUNITIES

LISSTT offers great opportunities to clean up large contaminated and problematic sites that would otherwise not be treated due to the high cost for traditional technologies for aquatic cleanups (i.e. dredging and ex-situ treatment). Furthermore, this technology is extremely adaptable and can be applied to a wide variety of sites, including small industrial process water ponds, small and large lakes, rivers and marine sites. Contaminants that are easily treated include: sulfides, phosphorus BTEX, TPH and PAHs.

PARTNERSHIP IN POLLUTION PREVENTION AND RESOURCE CONSERVATION

Development and refinement of the technology was made possible by the support of numerous groups including the Ontario Ministry of the Environment, Environment Canada, Dofasco Inc. and the Ontario Ministry of Natural Resources.

Industrial companies located in Ontario may seek ministry/industry services which will help them:

* reduce, reuse and recycle solid waste;
* effectively clean up historic pollution and destroy hazardous contaminants;
* reduce or eliminate liquid effluent and gaseous emissions;
* use energy and water more efficiently.

Equipment and services supply companies can benefit from the information provided on technologies identified for business development.

FOR FURTHER INFORMATION, PLEASE CONTACT:

Mr. Jay Babin
Limnofix Inc.
2180 Meadowvale Blvd.
Mississauga, Ontario. L5N 5S3
Phone: (905) 567-4444
Fax: (905) 567-6561
E-Mail: JBABIN@GOLDER.COM

George Cadete
Environmental Partnerships Branch
Ministry of the Environment
2 St. Clair Ave. W., 14th Floor
Toronto, Ontario
M4V 1L5
Tel: (416) 327-1258
Fax: (416) 327-1261
E-Mail: cadetege@ene.gov.on.ca

MINISTRY OF THE ENVIRONMENT SERVICES

For information on Ministry of the Environment assistance to industry, please contact the Environmental Partnerships Branch at (416) 327-1492, Fax (416) 327-1261

For more project profiles and other publications, visit the ministry's website at http://www.ene.gov.on.ca

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